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A Field Medical Surveillance System for Deployed Forces: A Conceptual Model

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An important function of any military medical service during combat operations is the prevention of infectious and parasitic diseases. Military personnel may be deployed in developing countries where various infectious and parasitic diseases are endemic, and the potential for widespread illness in US troops is a threat to combat readiness. Timely recognition of such illnesses requires systems to detect these diseases early so they can be quickly investigated and controlled before they become a major health crisis. Prompt detection requires careful monitoring and a thorough understanding of the trends in incidence and distribution of known endemic agents. Surveillance with appropriate laboratory support is critical to an effective defense against these potential illnesses. This paper describes a conceptual model for a Field Medical Surveillance System (FMSS) designed to assist military Environmental Health Officers (EHOs), and Preventive Medical Officers (PMOs) in the prompt detection and prevention of illnesses that may occur during foreign deployments or conflicts.

INTRODUCTION

The health of US service personnel deployed to foreign countries is vitally important to the successful completion of the intended mission. Upon relocation, these personnel represent non-indigenous populations exposed to the endemic diseases and other hazards associated with their assignment. Within these groups, outbreaks of infectious and parasitic diseases can render many individuals unable to perform their duties, place a severe strain on medical resources, jeopardize their missions, and possibly endanger the lives of those stricken.

Historically, infectious diseases have had a significant impact on military operations. In World War II, 55,668,000 man-days were lost from duty as a result of infectious diseases.[1] During the recent Operation Desert Shield/Storm (ODS/S) deployment to the Middle East, large outbreaks of diarrheal illness occurred in US troops. Incidence rates exceeding 10% of the force strength each week were reported in some units, and it was estimated that during the first month of the operation, at least 50% of all troops were affected.[2] One of the largest outbreaks was the occurrence of food-borne gastroenteritis in Jeddah, Saudi Arabia, during ODS/S, which affected 648 Air Force flight line personnel.[3] Other endemic diseases of military significance that posed a potential threat during ODS/S included hepatitis, leishmaniasis, sandfly fever, Crimean-Congo hemorrhagic fever, schistosomiasis, and malaria.[4]

One of the primary tasks for preventive medicine personnel at Echelon II is to conduct and coordinate medical surveillance for selected diseases of military operational importance.[5] During 1992 US troops who where deployed to Somalia to take part in Operation Restore Hope were exposed to a number of endemic diseases of that region, including dengue fever, malaria, and diarrheal diseases caused predominantly by enterotoxigenic *E. coli* and various species of *Shigella* .[6] To minimize the impact of these diseases, commanders strongly emphasized preventive measures. An infectious disease control team was deployed, and a medical surveillance system was put into effect. This system required all new outpatient visits to be recorded and classified into one of 14 diagnostic categories, such as gastrointestinal, acute respiratory infections, and unexplained fever. Once a week, or when conditions permitted, an epidemiologist visited each clinic and recorded the number of new outpatient visits for each of the fourteen diagnostic categories. These data were tabulated, and incidence rates based upon known troop strength then were calculated. An increase in incidence of any diagnostic category indicated a situation that needed further investigation.[7] Although this system helped pinpoint potential problems, it was time consuming and labor intensive. These aggressive efforts, however, helped to reduce the morbidity caused by these illnesses and emphasized the importance of having preventive measures in place.

To minimize the impact of disease on deployed forces, EHOs and PMOs need timely information with which to make *information-driven decisions*, better ways to communicate this information, and improved tools for analyzing and presenting the data. For infectious disease, the early warning provided by surveillance systems allows field commanders time to start various control activities. These activities may include isolating infective cases, immunizations, spraying pesticides, chlorinating wells, restricting food-handlers, and eliminating sources of open water.

The purpose of this paper is to present a conceptual model of a Field Medical Surveillance System (FMSS) that will allow for the timely recognition of adverse health events. The system will allow incidence and prevalence trends to be displayed and projected over the near term, and profiles of patient populations to be generated. By allowing prompt action to bring available resources to bear on emerging problems, an effective surveillance system in conjunction with appropriate laboratory support is a powerful tool in the defense against infectious diseases.

PREVENTIVE MEDICINE FUNCTIONS

For deployed units the epidemiological surveillance system should not require any additional labor beyond that needed to care for sick and injured personnel; therefore, to the degree possible, the system should use the data gathered primarily for clinical care. Analysis of clinical data would allow the following capabilities to be developed for EHOs and PMOs operating in the field:

1. **Detection of Illnesses Shortly After Their Onset** - Early detection would allow field medical personnel to quickly respond with appropriate control measures.

2. **Ability to Determine Both the Incidence and Prevalence Rates** - Determination of the incidence rate of a given illness would allow trends to be observed and comparisons made among different treatment facilities, while the determination of prevalence rates would allow bed usage and noneffectiveness days to be estimated.

3. **Projection of Short-Term Trends** - Estimating short-term trends would allow the adequacy of available resources and current disease control activities to be assessed.

4. **Ability to Profile the Characteristics of the Affected Population by Person, Time, and Place** - Having the ability to profile the affected population by various descriptive variables could be used to establish the major risk factors for a particular illness.

5. **Ability to Determine Mode of Disease Transmission** - Knowledge of the mode of disease transmission would allow preventive measures to be more focused.

6. **Compilation and Dissemination of Reports** - Results for the FMSS would be available on a timely basis to those individuals who are responsible for instituting preventive measures.

7. **Ability to Retrieve Medical Reference Materials** - Providing rapid access to current medical information that pertains to any of the diseases in the knowledgebase would ensure that the most current methods of control and prevention would be implemented.

DEVELOPMENT STRATEGIES

Two strategies were evaluated in the conceptual design for developing FMSS. The first strategy was to build a new system *de novo*, including building a knowledge base of endemic diseases considered to be of military importance. This knowledge base would consist of a "disease threat library" for each country, and it would include the clinical symptomatology, epidemiology, and therapy for each known disease from that country. This information can be obtained from the Armed Forces Medical Intelligence Center (AFMIC), which also publishes the Disease and Environmental Alert Reports (DEAR). These reports provide information on approximately 100 infectious and parasitic diseases considered to be of military importance.[8] This information is available to military medical planners and covers every major country in the world, and it is used extensively during predeployment briefs. The second strategy was to design a "front-end" system that would use an available infectious disease knowledge base, but would allow for additional modules to be developed. One candidate infectious disease knowledge base is the Global Infectious Disease and Epidemiology Network, or GIDEON.[9] GIDEON's knowledge base currently consists of 306 diseases (see Appendix), 205 countries, 556 bacterial taxa, and 137 antibacterial (fungal, parasitic, and viral) agents. This knowledge base uses literature published throughout the world, and it currently has more than 10,000 notes that outline the status of specific infections within each of the 205 countries. In addition, users around the world constantly add to the information pool, a critical and essential requirement given the rapidly changing status of newly emerging and drug-resistant infectious diseases. [10]

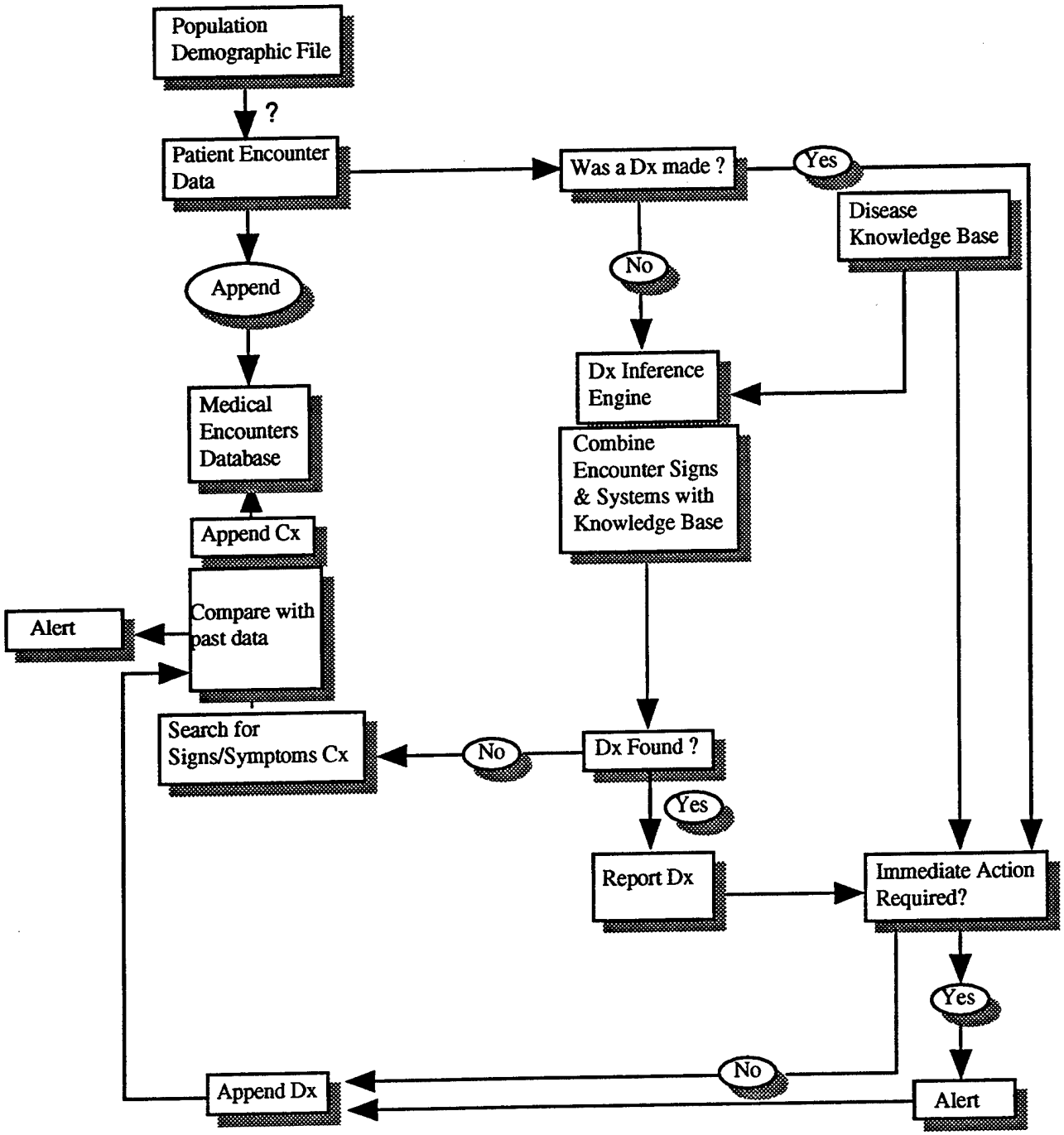
After consulting with Navy, Army, and Marine Corps specialists in the field of infectious diseases, it was determined that the most efficient use of time and resources would be to take the second approach and design a "front-end" system using the GIDEON's knowledge base. The crucial advantage here is that such a system will incorporate a knowledge base well known in the medical community. It is the product of more than 13 years of intensive collaboration between specialists in infectious diseases, epidemiology, microbiology, biostatistics, and computer sciences. [9,11] Although an interface specific to military requirements will need to be designed and implemented, it was concluded this approach was more desirable than trying to duplicate the enormous amount of effort that has already been achieved with the GIDEON knowledge base.

Overall the system will consist of an initialization sequence, patient encounter processing, daily compilation of encounter data, and periodic updating of the knowledge base. A screen that allows the user to initialize the system will be available during start-up. This screen will allow

descriptive information to be added and will consist of data fields to capture troop strength, battle field location using Global Positioning System, and name of Medical Treatment Facility (MTF). To track each acquired illness to a particular MTF, a unique four-digit identifier will be assigned to each MTF during the initialization process. In addition, the user will be able to update this information at any time. The first process shown in Figure 1 is initiated when a patient seeks medical attention. At this point an attempt is made to assign a diagnosis based upon his or her presenting signs and symptoms. The health care provider may make a diagnosis, or a diagnostic computer algorithm may be used to generate a differential diagnosis using a knowledge base of known endemic diseases for that particular region of the world. Frequently however, a diagnosis cannot be made, so the patient's condition is documented in terms of signs and symptoms. Consequently, the capability to find patterns or clusters of signs and symptoms is being developed. Two promising Adaptive Resonance Theory algorithms have been developed and tested on simulated data.[12] When a pattern or cluster is detected by the system, the results are returned to the health care provider for review, and for suspected conditions that require immediate action, an alert dialogue box is displayed. If a diagnosis cannot be made or a cluster cannot be identified, then the patient will be assigned to one of fourteen general diagnostic categories.

The second process is a daily compilation of encounter data and is shown in Figure 2. The compilation of this report will be initiated automatically each day. The patient visit data will be reviewed and counts or incidence rates will be computed for each diagnosis or major diagnostic category. From these data and information on etiology, disease prevalence will be estimated as well as the near term incidence. In addition, those cases in which a clear diagnosis is determined, the potential mode(s) of transmission will be known (eg, air, water, food, insects, rodents). From these data, totals will be calculated for each disease vector and reported each day. Knowledge of the exposure route responsible for causing the majority of illnesses allows medical resources to be directed toward that particular route of exposure. Finally, actual incidence rates will be given along with the previous forecasts so any increases or decreases can be monitored. Comparing the actual rates with expected rates provides a measure of the effectiveness of ongoing preventive medicine efforts.

Patient Encounter Processing



Dx = Diagnosis
Cx = Cluster

Figure 1. Overall structure of Patient Encounter Processing.

Daily Report Processing

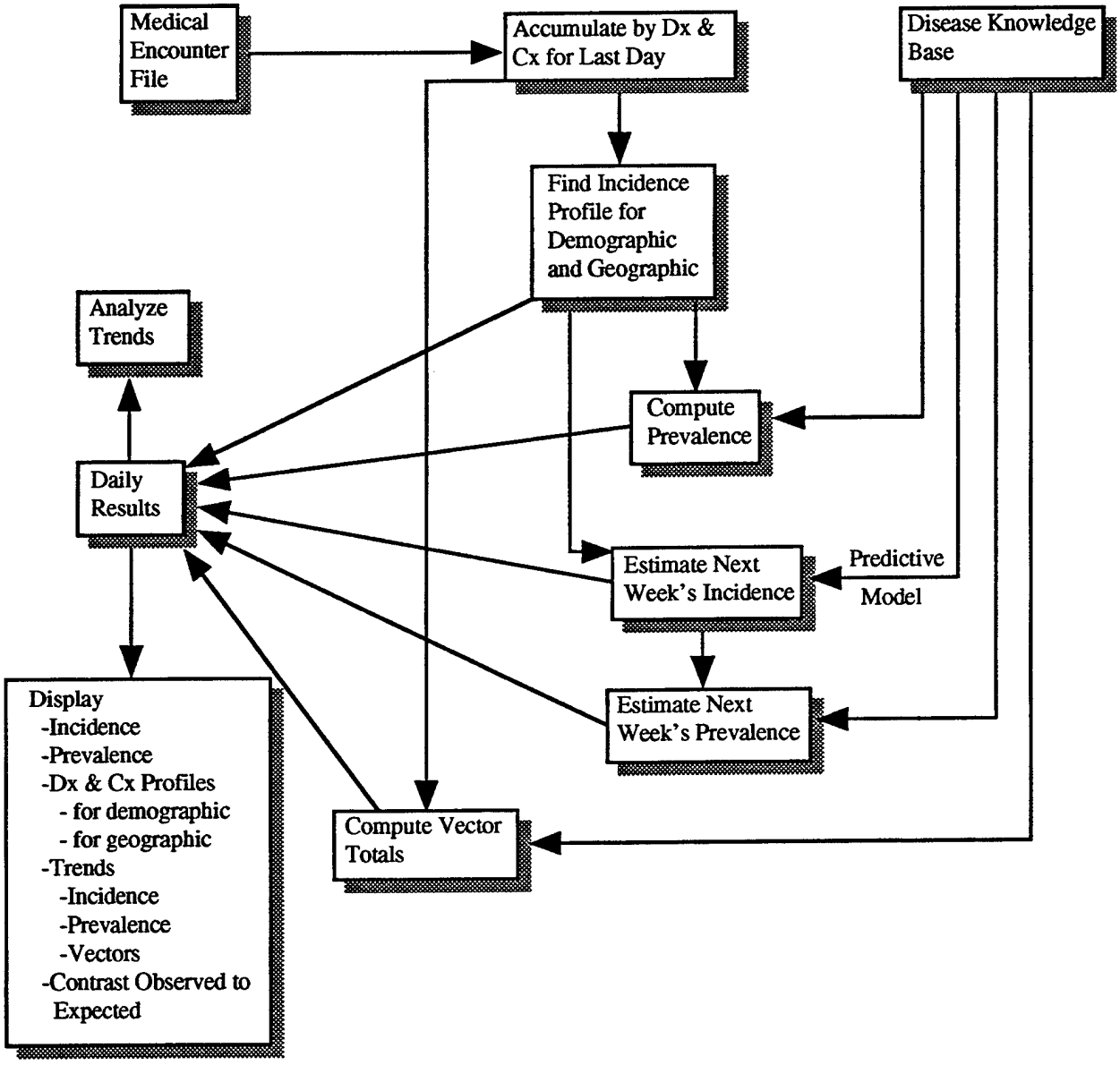


Figure 2. Overall structure of Daily Report Processing.

Knowledge Base Processing

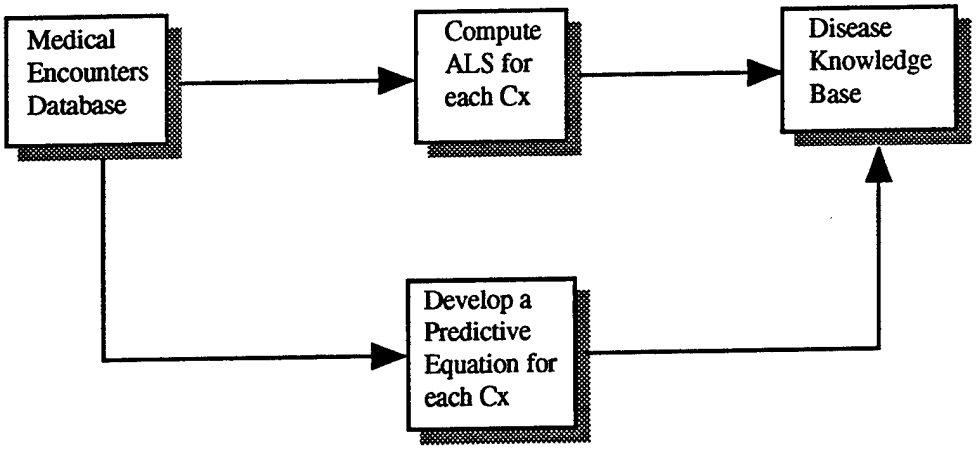


Figure 3. Overall structure of Knowledge Base Updates and Ad Hoc Reports.

The third process involves updating the disease knowledge base as shown in Figure 3. This process is simply a mechanism to use information acquired from the current military operation to help estimate average length of stay. Specifically, a series of patients may be seen for the same symptom complex but have no definitive diagnosis. This information, however, may be used to help determine bed requirements and the efficacy of any treatments that might have been administered.

Design

Under the first process four program modules will address specific issues within the FMSS. These modules will be Diagnosis, Epidemiology, Outbreak Investigation, and Surveillance.

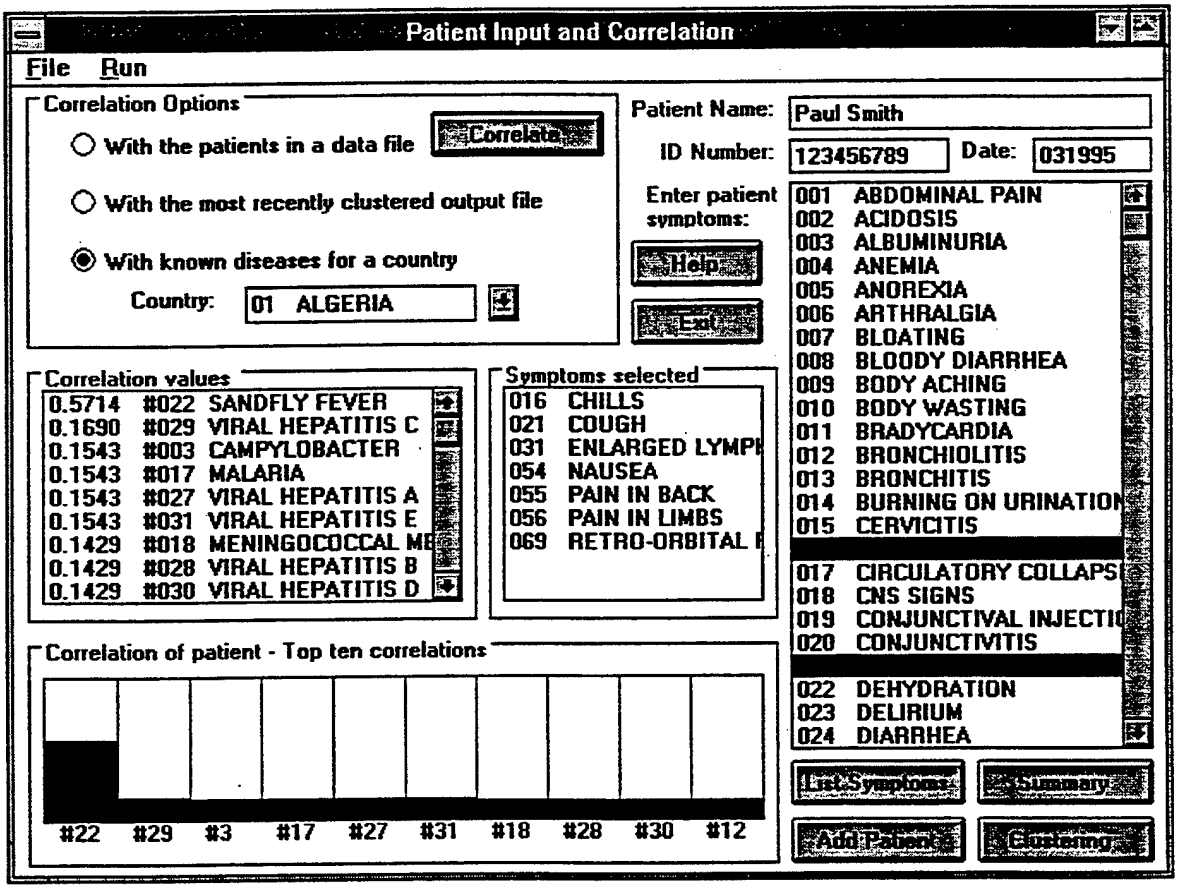


Figure 4. Prototype screen for Diagnosis Module within FMSS.

Diagnosis Module - Examples of two prototype screens for the Diagnosis Module are shown in Figures 4 and 5. The medical corpsman or attending physician will enter the patient's name and SSN, then choose the appropriate country from a pull-down menu. By clicking on the list of countries' diseases, a list of all infectious and parasitic diseases for that country are show in the window under Diseases for country chosen. As soon as the country is selected, a list of signs and symptoms for those diseases will appear under the title "Enter the patient symptoms." From this list, the user will select the signs and symptoms of the patient by clicking on any of the ones listed. The user can then click on the Show symptoms button and those symptoms selected will appear in the "Symptoms selected" box. To remove any of the selected symptoms, the user can double click and the system will return to the original list. After all the symptoms are entered, the user will press the button, which then correlates the chosen signs and symptoms with the list of endemic diseases. A bar graph will be displayed showing the relative probabilities of the first 10 diseases along with their names in the box above. In this example, the selected country was Algeria, the presenting symptoms were CHILLS, COUGH, ENLARGED LYMPH NODES, NAUSEA, PAIN IN BACK, PAIN IN LIMBS and RETRO-ORBITAL PAIN. The program determined the most probable disease was SANDFLY FEVER, given that combination of symptoms, with a relative probability of 0.5714, followed by VIRAL HEPATITIS C, with a probability 0.1690.

User input will be processed in the final version using Bayesian inference, which will not only use the signs and symptoms, but also will use ancillary information dynamically linked to data contained in the Epidemiology Module. These data may include incubation period, vector, and reservoir. In addition, a screen to input any laboratory results will be made available. Figure 5 shows an example of the Forecast screen for clusters. This screen displays the curve fit and the measure of the quality of the curve fit from the four fitting options (linear, exponential, self-limiting, and polynomial), plus the graphic and numeric 5-day forecast with one or two standard deviations along with the corresponding probabilities.

Epidemiology Module - The Epidemiology Module will be linked to the Diagnosis Module and will provide the user with additional information for a particular disease. It will follow the format found in the handbook, "Control of Communicable Diseases in Man", which the Navy has adopted and called NAVMED P-5038.[13] It includes the following information on each disease, if available: (1) IDENTIFICATION, (2) INFECTIOUS AGENT, (3) OCCURRENCE, (4) RESERVOIR, (5) MODE OF TRANSMISSION, (6) INCUBATION PERIOD, (7) PERIOD OF COMMUNICABILITY, (8) SUSCEPTIBILITY AND RESISTANCE, and (9) METHODS OF

CONTROL. This information will be linked to the diseases that appear in the list of differential diagnosis, and well as from the Diseases for country chosen list. When any disease is selected a screen will appear similar to that shown in Figure 6, and it will display all available information for that particular disease. Treatments for each disease will be listed under METHODS OF CONTROL, and will include current treatments as well as recommendations on any preventive measures that should be taken.

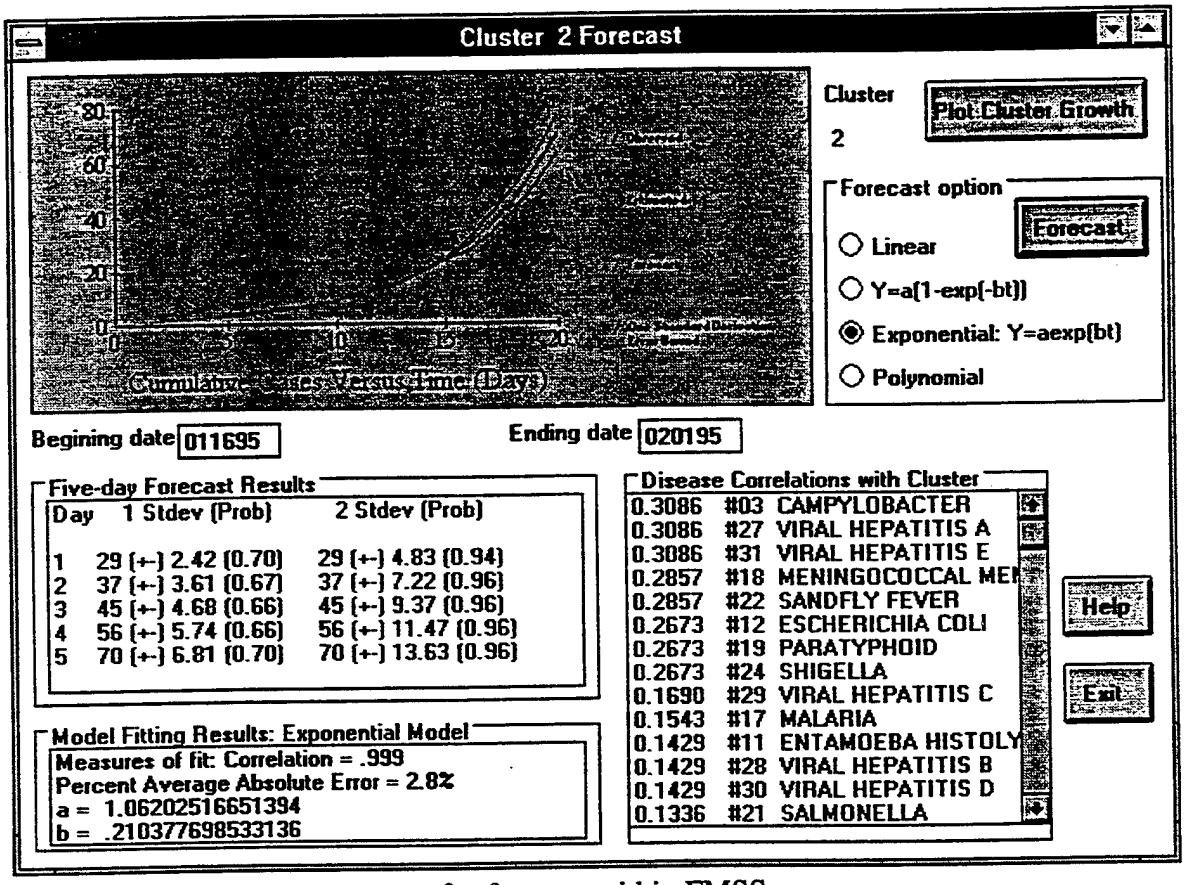
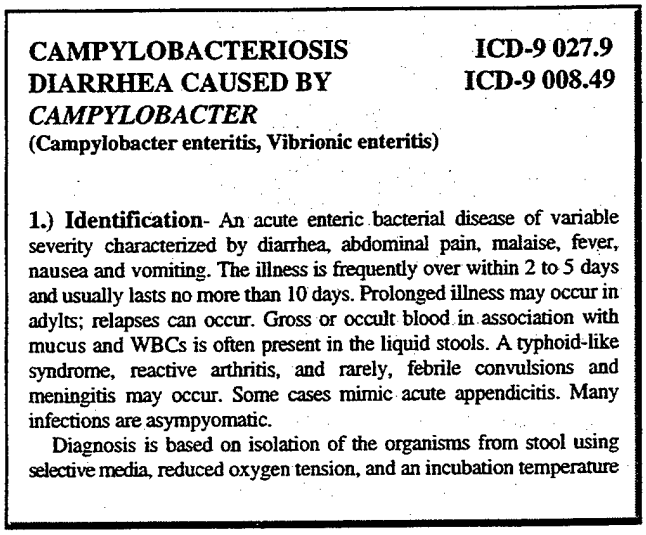


Figure 5. Prototype screen for forecast within FMSS.

Outbreak Investigation Module - This module will provide the user with a binary decision tree for investigating a disease outbreak. Frequently, a very systematic procedure has been developed for investigating the outbreak of a particular disease, and having on-line guidance will help ensure that each step is performed correctly. The user will respond to a set of defined questions with either a Yes or No, and each response will determine the next decision to be made. Having received a report or diagnosis of a suspected case of illness, the user will determine whether the condition is reportable. If the answer is No, then the task is completed. If the answer is Yes, the user will be asked to record and log additional information. After this task is complete

the user will then be prompted to answer another set of questions until the investigation has been completed. The Outbreak Investigation Module will consist of approximately 40 individual binary decision branches. It will be modeled after that used by the Centers for Disease Control and the World Health Organization.[14]



CAMPYLOBACTERIOSIS **ICD-9 027.9**
DIARRHEA CAUSED BY **ICD-9 008.49**
CAMPYLOBACTER
(Campylobacter enteritis, Vibrionic enteritis)

1.) Identification- An acute enteric bacterial disease of variable severity characterized by diarrhea, abdominal pain, malaise, fever, nausea and vomiting. The illness is frequently over within 2 to 5 days and usually lasts no more than 10 days. Prolonged illness may occur in adylts; relapses can occur. Gross or occult blood in association with mucus and WBCs is often present in the liquid stools. A typhoid-like syndrome, reactive arthritis, and rarely, febrile convulsions and meningitis may occur. Some cases mimic acute appendicitis. Many infections are asympyomatic.

Diagnosis is based on isolation of the organisms from stool using selective media, reduced oxygen tension, and an incubation temperature

Figure 6. Example screen for Epidemiology Module.

Surveillance Module - The Surveillance Module, like the Diagnosis Module, is crucial to the operation of the FMSS. Results obtained from the Diagnosis Module will be dynamically linked to the Surveillance Module, summarized, and plotted. The primary function of this module will be to process incoming data to detect disease trends that may signal an outbreak requiring the attention of preventive medicine personnel. An important component of the Surveillance Module will be the ability to make short-term projections on disease prevalence and noneffectiveness rates (see Fig 5). Having this capability will allow field commanders to better anticipate bed requirements, force strength, and patient regulation and evacuations. Knowing the average duration of an illness, the number of potential individuals at risk, and the rate of increase, one can make short-term projections on the number of lost man-days anticipated, provided no corrective actions are taken. This module also will provide an interactive capability for assessing the effect of potential interventions.

The ability to detect any unusual patterns in the surveillance data collected will rely on various statistical methods. One approach being investigated is collectively termed Statistical Quality Control. These techniques have been developed primarily for use in manufacturing, but they are increasingly finding their way into the medical field.[16] Another statistical method

commonly used with surveillance data is called the scan statistic. This method has been developed to answer the following type of questions: Is the number of cases for a particular disease reported for a certain time period excessive? The scan statistic is the maximum number of reported cases or events in an interval of predetermined length over the time frame of interest. It is used to test the degree of temporal clustering in a data set.[17]

CONCLUSIONS

Currently, systems are being designed and developed to capture and process medical data at the forward echelons of medical care. The data gathered can be processed to yield benefit to the practice of preventive medicine under combat conditions. To realize this benefit, however, methods for detecting medical problems need to be incorporated into these outpatient systems. Having the capability of using routinely collected data to assess the magnitude of field medical problems while following their progress will enable EHOs and PMOs to focus on areas of emerging health problems. Furthermore, this information will help to determine the amount and type of resources needed to bring a particular problem under control. In addition to having the ability to detect and monitor medical problems as they occur, this information also will provide commanders with the current numbers of noneffective personnel and estimate whether the numbers will potentially increase or decrease. With the development of portable computers and advanced communications, these methods can now be used in an operational theater.

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Appendix

Table 1. Diseases and pathogens included in the data base.

Abscess, intraabdominal
Actinomycosis
Adenovirus infection
Aeromonas & marine Vibrio infx.
AIDS
Amebiasis
Amoeba - free living
Angiostrongyliasis
Angiostrongyliasis abdominal
Anisakiasis
Anthrax
Argentine hemorrhagic fever
Ascariasis
Aseptic meningitis, viral
Aspergillosis
Babesiosis
Bacillary angiomatosis
Bacillus cereus food poisoning
Balantidiasis
Bartonellosis
Bertielliasis
Blastocystis hominis infection
Blastomycosis
Bolivian hemorrhagic fever
Botulism
Brain abscess
Brazilian purpuric fever
Brucellosis
California encephalitis group
Campylobacteriosis
Candidiasis
Capillariasis, hepatic
Capillariasis, intestinal
Cat scratch disease
Cercarial dermatitis
Chancroid
Chikungunya
Chlamydia infections, misc.
Chlamydia pneumoniae infection
Cholecystitis & cholangitis
Cholera
Chromomycosis
Chronic fatigue syndrome
Chronic meningococcemia
Clonorchiasis
Clostridial food poisoning
Clostridial myonecrosis
Clostridium difficile colitis
Coccidioidomycosis
Coenurosis
Colorado tick fever
Common cold
Conjunctivitis inclusion
Conjunctivitis viral
Cowpox
Crimean Congo hemorrhagic fever
Cryptococcosis
Cryptosporidiosis
Cutaneous larva migrans
Cutaneous leishmaniasis
Cyclospora infection
Cysticercosis
Cytomegalovirus infection
Dengue
Dermatophytosis
Dicrocoeliasis
Dientamoebal diarrhea
Dioctophyme renale infection
Diphtheria
Diphyllobothriasis
Dipylidiasis
Dirofilariasis
Dracunculiasis
Eastern equine encephalitis
Ebola Disease
Echinococcosis
Echinococcus - multilocular
Echinococcus vogeli infection
Echinostomiasis
Ehrlichiosis - E. chaffeenensis
Ehrlichiosis - E. sennetsu
Endemic syphilis (bejel)
Endocarditis - infectious
Entamoeba polecki infection
Enteritis necroticans
Enterobiasis
Enterovirus infection
Entomophthoromycosis
Epidural abscess
Erysipelas or cellulitis
Erysipeloid
Erythrasma
Escherichia coli diarrhea
European tick encephalitis
Far eastern tick-borne enceph.
Fascioliasis
Fasciolopsiasis
Filariasis - Brugia malayi
Filariasis - Brugia timori
Filariasis - Bancroftian
Gardnerella vaginalis infection
Gastrodiscoidiasis
Giardiasis
Glanders
Gnathostomiasis
Gonorrhea
Granuloma inguinale
Group C viral fevers
Hantavirus resp. distress syndrome
Hemorrhagic fever & renal syndrome
Hepatitis A
Hepatitis B
Hepatitis C
Hepatitis delta infection
Hepatitis, non-A non-B (enteric)
Herpes simplex infection
Herpes simplex encephalitis
Herpesvirus simiae infection
Herpes zoster
Heterophyiasis
Histoplasmosis
Histoplasmosis - African
HIV infection - initial illness
Hookworm
Hymenolepis diminuta infection
Hymenolepis nana infection
Ilheus
Influenza
Intracranial venous thrombosis
Isosporiasis
Japanese encephalitis
Karelian fever
Kawasaki disease
Kingella infection
Kyasanur Forest disease
Lagochilascariasis
Laryngotracheobronchitis
Lassa fever
Legionellosis
Leprosy
Leptospirosis
Linguatulosis
Listeriosis
Liver abscess, bacterial
Lobomycosis
Loiasis
Louping ill
Lyme disease
Lymphocytic choriomeningitis
Lymphogranuloma venereum
Malaria
Malignant otitis externa
Mansonelliasis - M. ozzardi
Mansonelliasis - M. perstans
Mansonelliasis - M. streptocerca
Marburg virus disease
Mayaro
Measles
Mediterranean spotted fever
Melioidosis
Meningitis, bacterial
Metagonimiasis
Microsporidosis
Monkeypox
Mononucleosis, infectious
Mucocutaneous leishmaniasis
Mumps
Murray Valley encephalitis
Mycetoma
Mycobacteriosis - M. marinum
Mycobacteriosis - M. scrofulaceum
Mycobacteriosis - M. ulcerans
Mycobacteriosis - systemic
Mycoplasma pneumoniae infection
Myiasis
Nanophyetiasis
Necrotizing skin/soft tissue infx.
Nocardiosis
North Asian tick typhus
Norwalk agent gastroenteritis
O'nyong nyong
Ockelbo disease
Oesophagostomiasis
Omsk hemorrhagic fever
Onchocerciasis
Opisthorchiasis
Orbital infection
Orf
Ornithosis
Oropouche
Osteomyelitis
Otitis media
Paracoccidioidomycosis
Paragonimiasis
Parainfluenza virus infection
Parvovirus B19 infection
Pasteurellosis
Pediculosis
Penicilliosis
Pentastomiasis
Pericarditis, bacterial
Perinephric abscess
Perirectal abscess
Peritonitis, bacterial
Pertussis
Pharyngeal & cervical space infx.
Pharyngitis, acute bacterial
Pinta
Plague
Plesiomonas enteritis
Pleurodynia
Pneumocystis pneumonia
Pneumonia, bacterial
Pogosta disease
Poliomyelitis (wild or vaccine)
Powassan

Pseudocowpox
Pyodermas (impetigo, abscess, etc)
Pyomyositis
Q fever
Queensland tick typhus
Rabies
Rat bite fever - spirillary
Rat bite fever - streptobacillary
Relapsing fever
Respiratory syncytial infection
Reye's syndrome
Rheumatic fever
Rhinoscleroma
Rhinosporidiosis
Rhodococcus equi infection
Rickettsialpox
Rift Valley fever
Rocio
Rocky Mountain spotted fever
Roseola or human herpesvirus 6
Ross River disease
Rotavirus infection
Rubella
Sabia
Salmonellosis
Sandfly fever
Sarcocystosis
Scabies
Scarlet fever
Schistosomiasis - haematobium
Schistosomiasis - intercalatum
Schistosomiasis - japonicum
Schistosomiasis - mansoni
Schistosomiasis - mattheei
Schistosomiasis - mekongi
Septicemia, bacterial
Septicemia, fungal
Shigellosis
Sindbis
Sinusitis
Smallpox
Sparganosis
Spondweni
Sporotrichosis
St. Louis encephalitis
Staphylococcal food poisoning
Strongyloidiasis
Subdural empyema
Suppurative parotitis
Syngamiasis
Syphilis
Taeniasis
Tanapox virus disease
Tetanus
Thelaziasis
Thogoto
Toxic shock syndrome
Toxocariasis
Toxoplasmosis
Trachoma
Trench fever
Trichinosis
Trichomoniasis
Trichostrongyliasis
Trichuriasis
Tropical phagedenic ulcer
Tropical pulmonary eosinophilia
Trypanosomiasis - African
Trypanosomiasis - American
Tuberculosis
Tularemia
Tungiasis
Typhoid and enteric fever
Typhus - endemic
Typhus - epidemic
Typhus - scrub
Urinary tract infection
Varicella
Venezuelan equine encephalitis
Venezuelan hemorrhagic fever
Vesicular stomatitis disease
Vibrio parahaemolyticus infection
Visceral leishmaniasis
Wesselbron
West Nile Fever
Western equine encephalitis
Whipple's disease
Wound infection
Yaws
Yellow fever
Yersiniosis
Zygomycosis

Table 2: Evaluation of a computer-driven infectious disease diagnosis program (percent)

Nature of infection

	bacterial	parasitic	viral	fungal	total	correct *
actual cases	150	30	100	15	295	222 (75.3)
hypothetical cases	97	60	33	10	200	128 (64.0)
total	247	90	133	25	495	
correct diagnosis *	186 (75.3)	60 (66.7)	88 (66.2)	16 (64.0)	350 (70.7)	
diagnosis included in differential **	236 (95.5)	87 (96.7)	124 (93.2)	22 (88.0)	469 (94.7)	

Country of acquisition

	Israel	Africa	Southeast Asia	Europe	Latin America	North America	Other
Number of cases	308	66	65	24	7	19	6
correct diagnosis *	205 (66.6)	54 (81.8)	54 (83.1)	16 (66.7)	5 (71.4)	12 (63.2)	4 (66.7)
diagnosis included in differential **	295 (95.8)	62 (93.9)	61 (93.8)	23 (95.8)	6 (85.7)	18 (94.7)	4 (66.7)

* concordance between correct clinical diagnosis and disease ranked first in the differential diagnosis list

** the correct clinical diagnosis is included in the computer-generated diagnosis list

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An important function of any military medical service during combat operations is the prevention of infections and parasitic disease. Military personnel may be deployed in developing countries where various infections and parasitic diseases are endemic, and the potential for widespread illness in US troops is a threat to combat readiness. Timely recognition of such illness requires systems to detect these diseases early so they can be quickly investigated and controlled before they become a major health crisis. Prompt detection requires careful monitoring and a thorough understanding of the trends in incidence and distribution of known endemic agents. Surveillance with appropriate laboratory support is critical to an effective defense against these potential illnesses. This paper describes a conceptual model for a Field Medical Surveillance System (FMSS) designed to assist military Environmental Health Officers (EHOs) and Preventive Medical Specialists (PMSs) in the prompt detection and prevention of illnesses that may occur during foreign deployments or conflicts.

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